

Abstract

Today, tourism comes at the forefront of the sources of national income, and what serves tourism is to provide an exceptional experience for the tourist, and in response to this matter, this project was, which is a smart glasses equipped with a voice assistant capable of translating the hieroglyphic language, and just as the wonderful discovery of Champollion unveiled the secrets of the ancient Egyptian civilization, this The project will offer the tourist a translation of texts written in hieroglyphics without effort, in addition to the feature of identifying historical figures and presenting information about them. It is also equipped with the ability to identify tourist attractions in addition to translation between natural languages, which provides the tourist with what he needs without the need for a tour guide, which makes it wonderful for him and increases the demand for tourism.

Smart tour guide (STG) is a technology that combines augmented reality with tourism. It is a wearable device that can provide visitors with information about the places they are visiting, making their experience more immersive and informative. The smart glasses tour guide works by overlaying digital information onto the physical world, enhancing the visitor's view of their surroundings.

Introduction

With the great progress of technology in our time, it has become necessary to introduce technology in all areas of our lives from agriculture. Industry, commerce, and tourism.

The choice fell on the field of tourism, which is an important source of national income for the country, and for all people to know the history of the ancient Pharaonic civilization.

In this project we produce a Smart Tour Guide (STG) to design and develop a technological solution that enhances the experience of tourists visiting ancient Egyptian sites by providing them with accurate information, effective communication. The Smart Tour Guide will be designed in the form of glasses, which will allow tourists to use it easily at any time and will be equipped with advanced hardware and software technologies to achieve its features.

STG provides the usual uses like kings' face recognition then providing information about them, translate ancient Egyptian language (hieroglyphics), capturing photos, playing music, searching about information, QR-code scanning and showing time. You can get all services easily using voice commands, which make it an easy-to-use product suitable with current evolution.

STG's major function is its capability to read and translate ancient Egyptian. The device also contains a personal assistant that can look up details about any king or queen in ancient Egypt and provide visitors fast access to that knowledge.

In our project, we also provide a solution for tourists to understand sign language. Also provide a solution for Landmark detection feature. However, this last feature are still not added to STG glasses, we hop to add them and other features in the future.

Materials & Methods

Hardware Components

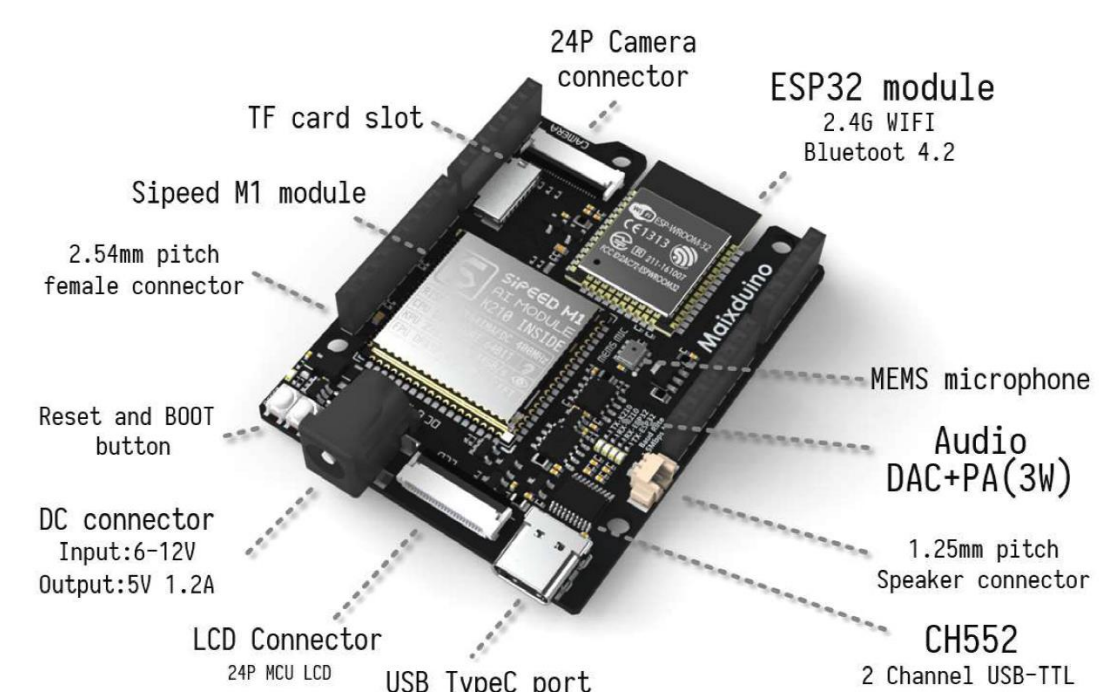
This project contains many component such as:

- ❑ **development board:** Maixduino Kit RISC-V.
- ❑ **Display:** 2.4-inch TFT Display
- ❑ **Camera:** GC0328 camera module
- ❑ **Wi-Fi and Bluetooth:** ESP32 Module.
- ❑ **memory:** SD card 8GB
- ❑ **Microphones:** MEMS Microphone
- ❑ **Speakers:** Stereo headphone
- ❑ **Audio plug:** Female 3Pin
- ❑ **Battery:** two Lipo Battery Cell 3.7V 1500mAh
- ❑ **3D printing case**



The most important component Sipeed Maixduino Kit RISC-V.

The Maixduino development board uses the powerful core unit. The module has a built-in 64-bit dual-core processor chip and 8MB on-chip SRAM. It has outstanding performance in AI machine vision and hearing performance with a total computing power up to ITOPS (FPU, Fast Fourier Transform Accelerator), which can easily implement machine vision/auditory algorithms for various application scenarios, it can also perform preprocessing for voice direction scanning and voice data output. In addition, the development board is also equipped with an ESP32 module (Wi-Fi + Bluetooth integrated), which can be easily connected to the Internet with simple operations.



Methodology

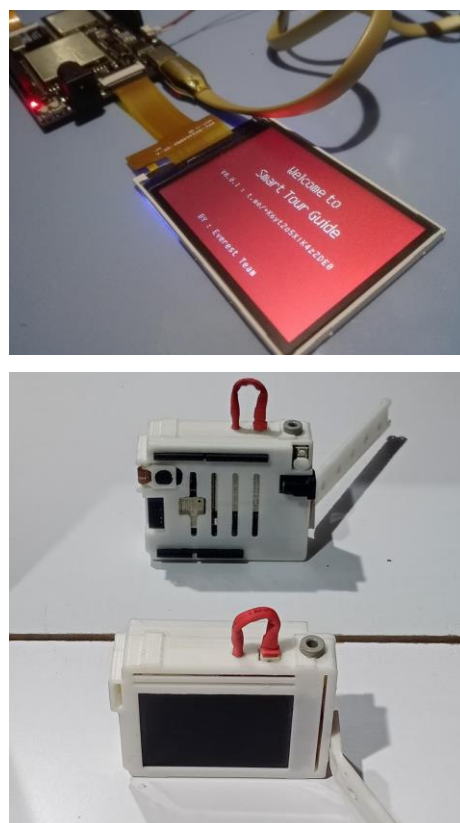
We have combined the previously mentioned components together within the 3D printed frames and connected the power using two batteries.

As Maixduino work with 6-12V, we used two Lipo Battery Cell 3.7V 1500mAh connected in so that the out put is about 7.4V with 1500mAh, this can operate the Maixduino board for about 1 hour.

Then we connected our display, camera, audio plug and speakers to the Maixduino.

After that we uploaded our code and data on the SD card, which has the *main.py* file that runs on board startup.

Finally, we got the final design of STG project, which has the design of wearable glasses.



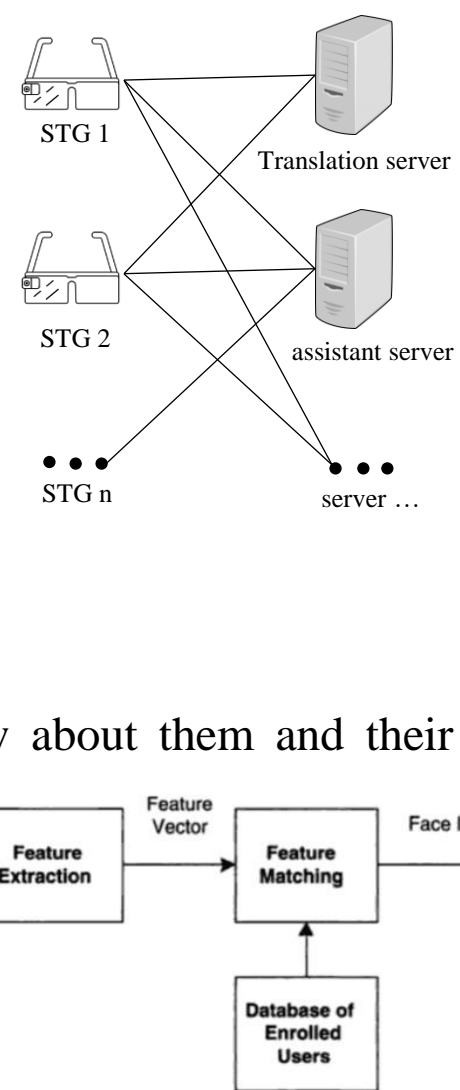
How STG system work?

Our smart tour guide project provides many services, which can be called by voice commands, as it uses an algorithm module for isolated word recognition by using commands vocabulary template, that we generated before. The specific identification process of this module is: pre-filtering, ADC, framing, endpoint detection, pre-emphasis, windowing, feature extraction, feature matching. Endpoint detection (VAD) uses a combination of short-term amplitude and short-term zero-crossing rate. After detecting the effective speech, according to the human hearing perception characteristics, the Mel frequency cepstral coefficient (MFCC) of each frame of speech is calculated. Then the dynamic time warping (DTW) algorithm is used to match the feature template, and the recognition result is finally output.



Some of STG's services are processed locally on the Maixduino board and Others are processed remotely on a server connected to the museum's network that provide this service.

It is worth mentioning that each services can run on different server to make the system more scalable. Current services that run remotely are isolated word recognition, face recognition, music playing and other services. But services that run remotely is ancient Egyptian translation, assistant, capture service, QR-code service and time service.



Identify statues of kings and queens

This service helps tourists to identify the king or queen, then tourists can know about them and their achievements.

This function has many steps: face detection, face alignment, facial features extraction and feature matching.

We have built two versions for this feature:

- ❑ The first version is one which is proposed in python and is suitable with boards that have higher resources like: Raspberry pi or computers. It uses python libraries such as: OpenCV and face recognition. It is suitable for large number of faces.
- ❑ The second version is one we use in this project, it is written in Micropython, it is more suitable for Maixduino board. It is built based on YOLO algorithm. It is very fast and accurate, but it is not suitable for large number of faces.

Hieroglyphic translation

This feature helps the tourist to understand the ancient Egyptian texts in a smooth manner. Basically, the algorithm has many steps:

- ❑ The camera captures a picture of the mural.
- ❑ Some pre-processing is done on the image.
- ❑ This image is entered as an input for the first algorithm to detect and recognize the cartouches in the mural and then extract the largest cartouche.
- ❑ And that cartouche is the input for the second algorithm responsible for detecting and recognizing the hieroglyphic symbols.
- ❑ And the arrangement algorithm works to form the name from those symbols, which are as follows:
- ❑ Given a set of hieroglyphic symbols, each associated with vertical coordinates, the symbols are sorted in the following manner:
 - The symbol with the minimum vertical coordinate value is placed first.
 - If there are symbols that intersect vertically, a check is performed on their horizontal coordinates.
 - If the minimum value of the horizontal coordinate of one symbol is greater than or equal to the maximum value of the horizontal coordinate of the other symbol, the symbol with the larger horizontal coordinate takes precedence and is placed before the other symbol.
 - The process continues until all symbols are sorted based on these criteria.
- ❑ but as a result of the lack of union In the arrangement method, some error results in the arrangement, and here comes the role of the modification algorithm in the arrangement, which returns the correct name.



Other usual services

STG system also provides other many usual services like searching in Wikipedia, showing time that gained on system startup using a time server, capturing photos that saved remotely where tourist can get it easily, reading QR-codes and playing music service.

Smart Tour Guide

Graduation Project

2023

Supervised by:

DR. Ali Ibrahim Siam, DR. Mona El-Naggar, Eng. Abdelmawla Yousef

Submitted by:

Mahmoud Hamza Abdella, Abdelraouf Abdelmonem Abdelhakeem, Ola Emad Naseem Zahran, Alaa Taha Muhammed El Maria, Yara Essam Mohammed Ellkany, Mohamed Yasser Ahmad, Abdelrahman Ibrahim Kamal Eldin, Ali Tarek Ali Muhammed

Results

Hardware

After connecting all hardware parts and testing the quality of all components, we will do implementation with our software part. When the glasses are turned on, a welcome message will appear in front of you and a voice assistant informing you of the features of the glasses. You can navigate between services using voice commands with a button which give you an option if single clicked and go back if double clicked.



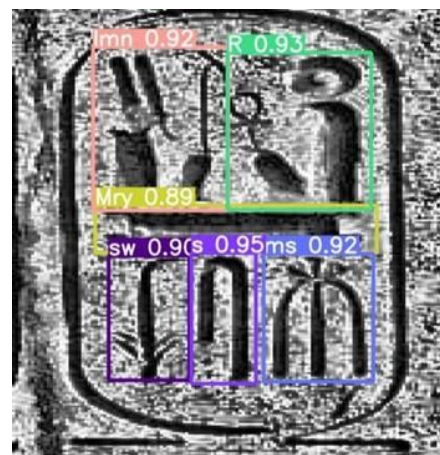
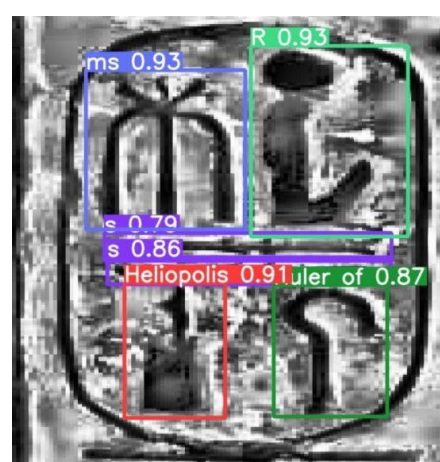
Face Recognition

after Comparing the face encodings of new, unseen faces against the known face encodings in your dataset. We Use similarity measures like cosine similarity or Euclidean distance to compute the similarity between face embeddings. If the similarity exceeds a predefined threshold, consider the face a match and recognize the individual. Otherwise, classify it as an unknown face.



Hieroglyphic translation

It's important to note that translating ancient languages can be challenging due to limited available resources, incomplete knowledge of the ancient language, and the potential for ambiguities and multiple interpretations. Collaboration with experts in the field and continual research and learning are often necessary to refine and improve translations of ancient languages.

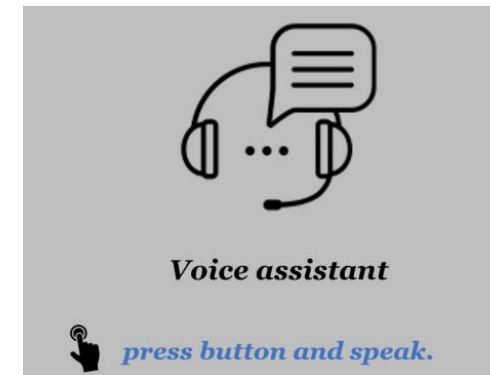


When user choosing the translate function, the camera opens and reads the visible symbols and determines what characters are in the image and translates them so that he can know the written name of the king and show it to the user.

We have done all previously mentioned steps and the result showed in the figure.

Assistant

When choosing the assistant function, the microphone will open, and the user will enter any question he wants to know the answer to, whether about kings, museums, or any question related to archaeological monuments, etc.



Then the program will take this question asked and search for it In Google, then it will show the answer to the question to the user, It is also equipped with a language translation feature, so it can translate from one language to another, and it has a feature to know what the current weather is like. It can play some music, videos or audio clip.

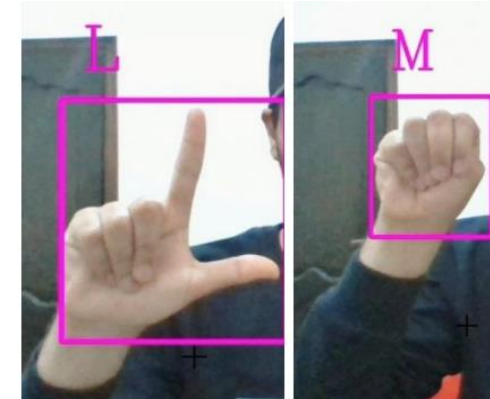
Landmark detection

Landmark Detection and Localization function that Apply the trained model to new images to detect and localize the landmarks. This involves extracting features from the test images, feeding them into the trained model, and obtaining the predicted landmark positions. Post-processing techniques like non-maximum suppression or outlier rejection can be used to refine the predicted landmark positions if necessary. Here is one of outputs.



Sign language

In sign language, each hand sign refers to a certain character. And the collection of signs can construct a certain word.



This feature is divided into two main steps: hand detection using MediaPipe and classification model trained to assign input data to one of several predefined categories or classes.

Final product

Smart tour guide (STG) is a technology that combines augmented reality with tourism. It is a wearable device that can provide visitors with information about the places they are visiting, making their experience more immersive and informative. The smart glasses tour guide works by overlaying digital information onto the physical world, enhancing the visitor's view of their surroundings.



Conclusion

Smart tour guides, powered by artificial intelligence, have the potential to enhance tourism experiences significantly. Smart glasses also offer historical and cultural context to landmarks, deepening visitors' understanding. Key features of our smart glasses include a voice-activated personal assistant that converts speech to text, searches Google for answers, and provides responses in text format. Another feature is facial recognition, which identifies kings and pharaohs and offers relevant information about them. The glasses can effortlessly read QR codes and barcodes, and capture souvenir photos. One of the most crucial features is their ability to recognize hieroglyphic texts, allowing users to decipher and understand them. STG system also provides other many usual services like searching in Wikipedia, showing time that gained on system startup using a time server, capturing photos that saved remotely where tourist can get it easily, and playing music service. Additionally, recognizing sign language. Lastly, the technology employs landmark detection to identify and provide information about archaeological monuments within museums. While challenges and benefits accompany the use of smart glasses as tour guides, they offer a unique and thrilling approach to enhance the tourism experience for all visitors.

Future work

- In the future, It will be possible to use it outside museums and tourist places so that you can move around and know everything through it.
- We hop increasing in capability of processing power to be faster.
- The possibility of having a conversation with the historical person using augmented reality technology.
- Using deep learning techniques so, it will allow the tourist to see what this person looked like in reality.
- In the future, we seek to generalize the translation to include the entire hieroglyphic text in any writing system, because the hieroglyphic language is characterized by containing more than 700 symbols and more than one writing system.
- Mapping will be placed for each part of the museum so that the visitor can move around and know every corner of the museum or tourist antiquity without the help of anyone, by placing a map of the museum for the project.
- We hop that the system will be able to translate a complete sign language.
- We hope to improve the means of guidance and guidance to replace the tour guide in a large way, as well as the means of communication through these glasses.

Acknowledgments

It has been a great opportunity to gain lots of experience in a real project, followed by the knowledge of how to design and analyze our project. For that we must thank all the individuals who made it possible for students like us to complete that project. We would like to express our deepest gratitude to our faculty of artificial intelligence and our graduation project supervisor:

Dr. Ali Ibrahim Siam for her patience and guidance along the year. In addition, we would like to express our sincere appreciations to our graduation project coordinator DR. Mona El-Naggar and Eng. Abdelmawla Yousef for their guidance, continuous encouragement, and great support.

We would like to thank President of Kafrelsheikh University and supervisor of the Faculty of Artificial Intelligence, Prof. Abdelrazek Desouki, and the Vice Dean of the Faculty of Artificial Intelligence, Prof. Tamer Medhat, for their efforts in the College to be the best.

And we would like to thank our college for the support, it provided us throughout the four years by providing all the available means for our production in the best and greatest way and extending us with science and knowledge to face the labor market after our graduation.

Finally, we would like to thank all the people who helped, supported, and encouraged us to successfully finish the graduation project.

For further information

You can contact the project teamwork on telegram through this link:

